DOCUMENT RESUME

ED 201 517 SE 034 910

TITLE	Women Inquire Into Science and Engineering (WISE), Audio-Visual Program for Students in Grades Six Through Twelve on High School Preparation for Science Careers Including Career Information Talks by Three Women, a Physicist, a Chemical Engineer, and a Physician.
INSTITUTION	Education Development Center, Inc., Newton, Mass. Women's Educational Equity Act Dissemination Center.: Richland School District 400, Wash.
SPONS AGENCY	Office of Education (DHEW), Washington, D.C. Women's Educational Equity Act Program.
PUB DATE	81
GRANT	G007702483
NOTE	22p.
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	*Audiovisual Aids; Career Awareness; *Career Education; Career Exploration; Elementary School Science; Elementary Secondary Education; *Engineering; Engineers; *Females; *Role Models; *Science Careers; Science Education; Science Instruction; Science Programs; Scientists; Secondary School Science
IDENTIFIERS	*Women Inquire Into Science and Engineering

ABSTRACT

Women Inquire into Science and Engineering (WISE) is a 22 minute audio-visual (slide/tape) program for students in grades six through twelve. Its purpose is: (1) to apprise students of the opportunities for them in the Inquiry Into Science and Engineering Class and encourage them to take the prerequisite math and science courses; and (2) to present scientific career information and advice by female role models. Included are presentation guidelines, vocabulary lists, and the complete text of the presentation. Three detailed career information talks by a woman physicist, chemical engineer, and physician are included as part of the presentation. (Author/DS)

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WOMEN INQUIRE INTO SCIENCE AND ENGINEERING (WISE)

AUDIO-VISUAL PROGRAM

FOR STUDENTS IN GRADES SIX THROUGH TWELVE

ON

HIGH SCHOOL PREPARATION FOR SCIENCE CAREERS

INCLUDING

CAREER INFORMATION TALKS BY THREE WOMEN,

A PHYSICIST, A CHEMICAL ENGINEER, AND A PHYSICIAN

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Prepared by

Richland Public School District #400
615 Snow Avenue
Richland, Washington 99352

under a grant from
Womens Educational Equity Act Programs

SE 034 910

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This report was prepared pursuant to a grant No. G007702483. The activity which is the subject of this report was supported in whole or in part by the Office of Education, U.S. Department of Health, Education, and Welfare under the Women's Educational Equity Act. However, the opinions expressed herein do not necessarily reflect the position or policy of the Office of Education, and no official endorsement by the Office of Education should be inferred.

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WOMEN INQUIRE INTO SCIENCE AND ENGINEERING - 1

INSTRUCTIONS TO PROJECTIONIST

1. Examine the cassette tape labels. One side has audible signals for manually advancing the slides. The other side has inaudible signals. If your projector is equipped for inaudible signals, connect it to a slide/sync cassette recorder.

2. Place the carousel tray on the projector at the "0" slide number position.

3. Place cassette in a cassette player. The rewound tape should be on the left spool. Start cassette. Stop it as soon as you hear music.

4. When the music begins, turn on the projector, and advance slide #0 into the viewing position. Slide #0 is blank.
   For automatic advancement and inaudible signals: The inaudible signal on the tape will advance slide #1 into viewing position as the music ends and a voice is heard saying, "Women inquire into science and engineering. Where does it all begin?" Slide #1 contains the first picture in the series.
   For manual advancement: Move to slide #1 when signal is heard. Slide #1 is heard saying, "Women inquire into science and engineering. Where does it all begin?" Move to slide #2 when the next signal is given.

PRESENTATION GUIDELINES

1. Although the information is directed to girls, it is applicable to boys. Make every effort to include them.

2. A vocabulary list is included. This might be helpful at some grade levels. It could be given on a day prior to the day of the program.

3. Introductory remarks about the importance of taking math and science courses in high school can be emphasized through the use of two inclosures: "Why take more math?"[1] and "Participation rates in high school mathematics and science courses."[2]

4. Projection of the program takes about 22 minutes.

5. After completion of the program, the Mentor Program can ideally be introduced. This is a one-to-one relationship between a student and a professional person working in the student's field of interest. (See: "WISE Adopter's Manual for further information.) Names of interested students can be collected.

6. If you have invited a role model to accompany this audio-visual aid, the remaining class time should be given to her or to him. If not, you might discuss what the women stressed--enthusiasm, communicative skills, strong math and science background, perseverance, etc. Include terminology.

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[1] Anon. 9/29/77 Why take more math? Office of Affirm. Act., Univ. of Wash. DW-08, Seattle, Wash. 98195.

[2] Remick, H., K. Miller. May 1978. Participation rates in high school mathematics and science courses. The Physics Teacher. pp. 280-282.

WOMEN INQUIRE INTO SCIENCE AND ENGINEERING - 2

VOCABULARY LIST

Terminology is listed here in the order in which it appears in the script.

engineering — A profession which makes economic use of materials, money, and personnel to provide a broad range of services and facilities through proper planning, design, construction, and management. It is divided into numerous branches or "fields", dealing chiefly with the application of scientific knowledge for purposes useful to people. Examples: chemical engineering, electrical engineering, civil engineering, and mining engineering.

biology — A science involving the systematic study of life in all its physical manifestations. Its two main divisions are botany which treats of plant life and zoology which treats of animal life.

chemistry — A science involving the systematic study of the structure, composition, and properties of substances and of the changes that they undergo.

physics — A science involving the systematic study of matter and energy and of the laws governing them under conditions susceptible to precise observation, experimental control, and exact measurement. It includes subjects of mechanics, heat, light, sound, electricity, magnetism, and radiation.

polygraph — A device for recording variations in the heartbeat and in respiratory movements.

computer — A power-driven machine equipped with keyboards, electronic circuits, storage compartments, and recording devices for the high-speed performance of mathematical operations.

dosimeter — An instrument for measuring the dosage of radiation.

neutron — An electrically neutral particle of the atom, having a mass approximately equal to that of a proton.

irradiate — To treat with or subject to X-rays, ultraviolet light, or other radiant energy.

fluoride — A chemical compound of fluorine and another element.

Fast Flux Test Facility (FFTF) is a sodium-cooled fast flux reactor designed specifically for irradiation testing of fuels and components for a new generation of nuclear power producers--liquid metal fast breeder reactors. Fast flux refers to the speed of neutrons in the reactor core during the fission process. In a breeder, neutrons produced during fission are not moderated, or slowed down, as they are in conventional light water reactors.

This fast neutron energy enables "breeding" or production of fissile material through the impact of neutrons on fertile Uranium-238. In other words, it "breeds" more fuel. The FFTF is a test facility only and it will not be used to "breed" plutonium nor produce electricity. Liquid sodium is the coolant. Sodium is a liquid between 208°F and 1,616°F.

technician or technologist — One skilled in the handling of instruments or in the performance of tasks requiring specialized training.

research scientist — A scientist who conducts systematic investigations by experimental methods.

Olduvai Gorge — A gorge about 100 miles southeast of Lake Victoria in Tanzania, the site of many fossils of extinct mammals, including Zinjanthropus, believed to be a forerunner of early man. (The archeological dig pictured is the Marmes Rock Shelter on the Palouse River in Southeastern Washington State.)

economical — Careful and provident in management; not wasteful nor extravagant.

computer programer — One who sets a sequence of instructions on the control panels of an electronic computer as guides in the performance of a desired operation.

physician — One legally authorized to practice medicine; a doctor

internship — A one year period in which new doctors undergo resident training in a hospital.

pediatrics — The practice of medicine as it pertains to children.

clinical medicine — Observation and treatment of patients in clinics.

hematology — The branch of medical science that treats of the blood, its formation, and diseases.

monographs — A description of one thing or class of things, written in great detail.

AUDIO & SLIDES

SCRIPT

1
Women Inquire Into Science and Engineering. Where does
2
it all begin? --Probably with one's own natural curiosity
3
fostered and directed by parents and teachers. It is
4
hoped that this presentation will give guidance to you,
5 6
who are making course decisions. The classes you take
7
have a bearing upon your future education choices and
8
consequently, your career options. If you have a vague
interest in an occupation in science, take math, too---
9
and drafting. Learn to work with tools, either at home
10
or in shop classes at school. Then, if you should later
become definitely interested in pursuing a science ed-
11
ucation, you will be equipped with the proper background.
A class called "Inquiry Into Science and Engineering" is
offered at Columbia High School, Richland, Washington.
It was initiated and is conducted by teachers, Jim Harbour
12
and Ed Pankhauser. The class is open to seniors who have
had biology, chemistry, physics, math and have had ad-
13
vanced courses in science and math. They take all their
classes in the morning including an hour in the Inquiry
Class. Classroom work consists of units in integrated
14
science; that is, science as it really is -- involving
knowledge and skills from math and the separate sciences,
library research, and oral and written reports. In lab,
15
you see Deanna and Janet operating the polygraph while
Lynn and Ruth are at the computer. In the afternoons,

they work with scientists and engineers at the nearby Hanford Project or in community health service laboratories. 16 For example, here you see Lynn working with a microscope 17 and using tweezers with tiny pieces of metal to be used as dosimeters to measure the neutron levels in sample materials 18 to be irradiated. Ruth works in a chemistry laboratory and is shown determining the fluoride level in water sampled from the main laboratory area. 19 Brenda and Todd are assisting with the reassembly of a simulated fuel assembly being used in equipment tests. 20 Vickie works with engineers at the Fast Flux Test Facility site, 21 checking blueprints and component locations in the FFTF to help assure that equipment is built and installed as designed. 22 Janet is shown doing computer programming and graphically displaying data from scientific experiments and analyses. These students not only receive on-the-job training but they also are paid the minimum wage while receiving credit at school. Some have been hired for the summer before going on to college. 23 Not all science opportunities require a college degree. Many good positions are open to those who are high school graduates or technologists 24 or have associate degrees--which require two years of study. 25 Many women make a late decision to enter science. If they have taken the proper courses, there is no problem. If they

have not, extra time is required to take courses they
26
missed. Sometimes they settle for work which is less
interesting or challenging to them. This represents a
loss to them and to the Nation's resource of science
27
talent. Three women who are working in science, engineer-
ing, and medicine, respectively, will talk to you now
28
about themselves and their work. The first is Denelle
Friar, a physicist.

29
I am a research scientist, a physicist, and I have wanted to be a physicist for most of my life. In the sixth grade, I became interested in nuclear structure
30
and that was my first step on this path; but I want to tell you about a very significant aspect of it for me personally, and one which has a second important meaning. When I decided to become a scientist, I had an image problem, a very serious one. When I grew up my role models were women in the movies and television
31
who were scientists, and they were of two varieties. They were the very serious, very stern countenanced, very straight-laced kind of women, who walked around in heavy, clompy shoes and lab coats, with their hair pulled back in a bun, and wore heavy glasses; who were
32
always cold and rejecting. And there was the second kind, who were unbelievably beautiful women--fashion models, if you will. They were professionally incompetant, but very beautiful to look at. I am not a very beautiful woman so I decided that naturally then, I must become
33
one of the first type, and I very carefully set about making this image for myself. I grew my hair long, pulled it back, straight, did not wear makeup, bought the heavist, most awkward shoes I could obtain, all very plain dresses, unflattering styles, and drab colors. I allowed myself to become overweight and did nothing about

that, rejected friendships, generally maintained a very aloof attitude toward everyone. As you can imagine, by the time I nearly completed college I basically hated myself; and, at this time began to realize that I didn't have to have this image, 34 that I could be myself. But I maintained one very, very, important illusion in my new more honest self-concept--one illusion that I never quite rejected. It was sort of a hold over--the belief that women scientists must necessarily remain single--that a woman scientist might look all right, but she would never really be appealing. Fortunately, my husband never saw the 35 same movies that I saw. I have told you this because it represents a more important principal. There are 36 two things that a scientist must be. A scientist must be systematic by nature, must have a love of logic, 37 must like to look for patterns everywhere, whether they be historical events, or groups of people or colors 38 or landscapes--anything that offers a complex view. 39 Always look for patterns of common things or differenciations. Have a sense of curiosity. Be interested in how things work. What are the underlying 40 principals? What are the common elements? Why is this thing related to that thing? 41 Do not become easily discouraged. I very much admire Dr. Leaky, who spent 20 years exploring the Olduvai Gorge before he decided on a place

to dig. That is persistance, by definition, I think. All of these things you expect, and this is my image of the stern, dedicated scientist, the cold and analytical person. But a scientist must be more than that. You must allow yourself to be a human being because we must, after all, function in a real world, and so, there are my real world characteristics too. You should allow yourself to be enthusiastic, like your work, be excited about the discoveries you are making. Become amazed, become astonished, become delighted with what you see happening in your experiments or in your calculations. Allow yourself to be excited about these things. Learn communication skills, verbal and written, very important! One must write reports, one must write letters and one must also be able to talk to colleagues at large conventions. You must be able to explain your discoveries, after all, and in an entertaining way if that is possible; and the most important, the most important characteristic for a modern scientist, is the ability to work on a team. You must seek to understand other people so that you can accept their fallibilities and short-comings as well as your own, to be able to give and take orders, and to be able to come to agreeable compromises. Very little scientific work these days is done by an individual. Nearly all of it is done by team work. So do not make the same

mistake that I did and assume that you must cut yourself off from humanity to become a scientist. You must become quite the opposite. Try to achieve a balance. Be yourself, and very good luck to all
53
of you. (Music)

54
Our second interview is with Cheryl Knox, a young, single, chemical engineer.

I was not interested at all in engineering until my second year in college, when it began to dawn on me that as a math major, I really wasn't coming up with
55
a career. Majoring in math was very interesting, I enjoyed my math classes but I was not going to have a job, and at that point in time, I realized that at the end of four years, I had to have a job. I had to have
56
some way of supporting myself. I started looking around at what careers were available and people began telling me, "Well, if you like science and math, look into engineering", and I did. I decided to major in it. I chose chemical engineering because I liked
57
chemistry, and that's how I wound up with a degree in chemical engineering. The hardest thing about pursuing an engineering degree and going through engineering school is not that you need to be a genius to become an engineer. It's the fact that they demand
58
a lot of work out of you. You have to spend a lot of time getting that work out, and you have to give up some recreational activities. You give up some basketball games. You give up a few parties. This is a hard thing to do when you're young and all your friends who are in less disciplined majors are going out and
59
having a good time. But now I realize that it was all worth it, because now I have both the finances and the free time for finally pursuing my personal interests,

such as scuba diving, skiing and traveling around and seeing this new area of the country that I moved to when I took my job. I had no real major obstacles to overcome as far as college went, other than my own laziness at getting the work out. The recruiters, when you talk to them on campus, are very interested in women in engineering. A lot of it has to do with the affirmative action programs that they all have going for them. But once you get on the job, there you run into the old attitudes and ways of thinking. You can't be overtly discriminated against, but you might find yourself in a position where you're given a little bit less responsible work than you're capable of doing. Well, the only thing you can do is do the best you can and show them that, yes, a woman is capable of doing this type of job, and that's sometimes an obstacle to be overcome. When you run into this kind of situation, don't just sit back and let it wash over you and accept the menial tasks in engineering, because there are menial tasks in engineering like there are in any other field, and demonstrate that you're a capable person. I think that that's a difficulty encountered in engineering for women that isn't encountered in other feminine occupations. It's expected of you that you will be a competant secretary, or a competant clerk, or a competant salesgirl in a department store, but people don't know quite what to expect of a woman engineer. Well, show them that you're just as good

and competant as the male engineer. I'm very proud
72
that I am an engineer. That is a really tremendous
reward to me, that I can sy with pride that I am a
chemical engineer. I like what I am doing and I enjoy
73
my profession. With so many people, you hear them talk
how they wish they had done something different with
their life; they wish they had a different profession,
a different career. I'm very proud that I enjoy doing
74
what I am doing, and I wouldn't change the decisions
that I've made. That to me is a greater reward than
any of the financial benefits you get from being an
engineer. Any girls who have leanings toward math or
75
science at all, I would encourage to take thes courses
and not close your mind to engineering. You're going
to be in your second to third year of college before
you make a definite decision anyway, but get the good
76
background, get the math and science, and even if you
decide that engineering is not for you, that background
will never hurt you. Even if you never take a job in
your life, a math and science background will never
hurt you. It can only be beneficial. A lot of times
students ask me, "Yeah, but what does an engineer
actually do on the job?" Well, there is tremendous
77
variety to engineering. You know there are a number of
different engineering fields. You've got civil,
mechanical, electrical, chemical, many, many branches

to engineering, and there are many types of engineering
78
jobs within each of these branches. You could be the
engineer who is in the plant all day with a hard hat
79
and boots getting dirty. You could be the engineer
80
who never leaves your office. You could be the engineer flying around the country consulting with a different firm in a different city each week, or you can find a job that's maybe a combination of all these
81
that will suit your own personality. As for myself on the job, I found that communications have been very important. You're given a problem. You do the calculations at your desk. You come up with some results and some recommendations and you've got to present them, and the better that you present them, the better
82
that that reflects your work. You've got to put it in concise writing, and then you've got to have meetings and discuss with people what you've done. In any given day, I may do a cost estimate of a process we're thinking about doing and then I'll call a meeting with all the people that are interested in this process --maybe some people in the lab, and some people in my group and we'll talk about it. Does it look good? Should we continue it? Should we forget about it because it
83
is not going to be economical? Then I write a letter discussing what came out of this meeting. Maybe I'll turn to the computer to help me solve some of my

problems, and I'll dial in on the telephone to the computer and come up with a simple little program. The computer programmers themselves will do major programming for you, but simple programs engineers
84
are expected to do themselves. If you actually work out in a process plant, you may go out and direct the mechanics and laborers to turn the valves on a
85
piece of equipment. An engineer, even a field engineer, has labor union rules he or she has to follow. You have to be careful that you do not
86
overstep the boundaries of your position, but you are the one directing these other people to put a certain piece of equipment together, start it up, change it, or help it to run more efficiently. It's this diversity that makes engineering so re-
87
warding to me. (Music)

88
Our final interview is with Dr. Sara Zirkle, a physician.

The people who influenced me most about my career choice were my parents. I think you could fairly say that their influence was a positive one rather
89
than a negative one, but for different reasons. My father was a physician himself and though he never put any pressure on me to make a career choice, I saw him as a person who enjoyed what he did, and was a very successful person at doing his job. My mother was trained in a career of social work; however,
90
she never practiced her career, that I remember. Her feeling, however, was that every person should be able to support themselves in a position which was both enjoyable and creative. For this reason, she encouraged me to seek a career which would provide me
91
with this kind of a situation. I remember first being exposed to science courses on a high school level and enjoyed them from my very first exposure in the ninth grade. However, I was not sure that I wanted to be in a scientific career until I was well
92
into my college years. In fact my final choices were not made until my senior year in college. I decided to apply to medical school. Because I liked science courses, and I wanted to work with people, I felt
93
that this would be a good choice. To become a physician requires a rather involved training period. In addition to the four years of college, four years

of medical school are usually required. During this time basic skills are taught and some clinical courses are given in introductory form. Subsequent to the four years of medical school, an internship is the next step. This can be done in a speciality field or in general medicine. Many physicians stop after the internship and practice general medicine or family medicine. However, there are increasing numbers of young people who are choosing to practice in a field of specialty work. This requires an additional three or four, or up to ten years of training, depending on the particular specialty. My area, which is pediatrics, or the practice of medicine as it pertains to children, requires two years of training after the internship in pediatrics. Some people subsequently decide to subspecialize and by that, I mean they go into a particular area of practice within a speciality, for instance --pediatric hematology is such a specialty. This involves treating only children who have blood diseases, so that you can see that there are a lot of options and flexibility within the practice of medicine. In addition to clinical medicine, there are many options in research which are open to people---or combinations, particularly for people who want to remain in the university setting. For myself, I find clinical practice very

104
rewarding. Again, I think this is because I like working with people and I do enjoy my work a great
105
deal. However, I've limited my practice to half time for these few years while my children are young and I feel that my family needs me at home. In addition, I have some time for myself, that way.
106
I think it's important for you all to realize that if you're interested in a scientific career, your study and training does not end with your formal education. I have found it necessary to continue my education on a daily basis. I regularly read at least three journals, sometimes text books and monographs and, even at this stage, I attend several
107
meetings a year. I guess it sounds like there's a lot to be done and indeed, there is. I think this has been a major obstacle for me in trying to fit
108
everything into my schedule. I enjoy being home and being a wife and mother and I think indeed this takes priority over my professional career at this partic-
109
ular time and maybe it always will. I think basicly, there are two rewards for me in my present position. One is having the opportunity to continue working in a stimulating field that I have enjoyed for so many years; and the second is providing a service which is much needed for children. Though

there is a monetary reward for any profession, I don't think this is one that I would consider primary. However, I do know that if there were ever a time when I needed to support a family, I could by working full time. 110 To you, who are now in high school, I would like to make the following suggestions: aim high, take all the math that you can take, and try to get to know someone who is already practicing the profession in which you hope to become involved. Perhaps these little talks will help you get an idea of what lies ahead, but to understand it on a deeper level, it is important to know someone well enough on a day-to-day basis so that the problems and rewards of the profession can be known to you. 111

(Music, After 5 seconds, show next slide.)

Five slides of Credits and Disclaimers (including 111)

112	5 seconds
113	5 seconds
114	5 seconds
115	5 seconds